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write record. The information from the management information table for the sub disk control device 33 is used, as is the number of transfer records of LOCATE command, the number N which is analyzed by the channel command analyzing section 31, and average record length, L. Here, the straight line (I) can be explained by an equation as shown below using known values of command chaining time Tsg between the main and sub external storage control devices, the above analysis, and the data transfer velocity V between the main and sub external storage control devices 3 and 8.

$$Ts=NL/V+(N-1)Tsg \qquad (1)$$

The straight line (II) shows the transfer time Ts', which is a constant value, for the case where data of one track is transferred together and where each record length is L, and number of records in a track is Na. Ts'can be represented by the following formula.

$$Ts'=NaL/V+Tsg \qquad (2)$$

In the case of the sloped line (I), as the number of records increases, the processing time increases. At some point, i.e. for some number of records, it is faster to send the entire track of data, because the command chaining time Tsg is too great.

The section for judging commands to be issued to the sub disk control device 32 judges whether to issue the command chain to the sub disk control device as received from the channel device or to transfer data of one track all together based upon the information contained in FIG. 6, in view of the number of records N.

FIGS. 5 and 6 illustrate a case in which six records are to be written in a track that holds eight records of data. As seen from FIG. 4, transferring data of one track all together requires less processing time if the number of records is greater than 4. FIG. 6 also illustrates such a relationship according to the intersection of lines I and II. Command issuing section 35 issues the best suited command-chain to the sub disk control device 8, in view of all of the considerations mentioned above and according to the instruction of command judgment section 32.

FIG. 3 illustrates command chaining between a CPU (channel device or host) and a sub disk controller via a main disk controller. As shown, a number of commands have to be sent back and forth before a record (R1) can be transmitted. The same sequence is followed for subsequent records.

According to the present invention, write processing time to a sub disk storage device, i.e. back-up processing time, can be minimized by selecting a command-chain method to be issued to the sub disk control device. This is accomplished by comparing processing time for the case of issuing the command chain to the sub disk control device as received from the channel device with that of the case of transferring data for a write record, or, data of plural tracks including a write record all together.

FIG. 7 illustrates the flow of steps according to the present invention. First, the amount of data that is to be sent is calculated (STEP 100), i.e. the number of records. Then a time T1 is calculated (STEP 110). T1 is equal to Ts using equation (1) above, and is computed for the case of sending individual records. Then, a time T is calculated (STEP 120). T2 is equal to Ts'using equation (2) above, and is computed for the case of sending the entire track of data. In decision block 130, it is determined if T1>T2. If so, then the entire track of data is sent (STEP 140). If not, then the individual records are sent separately (STEP 150). This process is repeated as necessary.

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Although the present invention has been described above in connection with the preferred embodiments, one of ordinary skill in the art would be enabled by this disclosure to make various modifications to the preferred embodiments and still be within the scope and spirit of the present invention as embodied in the appended claims.

What is claimed is:

1. A first external storage control device which is connected to a first group of external storage devices and controls data transfer between said first group of external storage devices and a host, wherein

said first external storage control device is connected to a second external storage control device which is connected to a second group of external storage devices;

said first external storage control device being equipped with a storing means that stores write data transferred by a write command from the host and means that transfers the write data stored in said storing means to the second external storage control device according to a write command;

the first external storage control device also having means for storing the write data to both an external storage device belonging to said first group of external storage devices and to an external storage device belonging to said second group of external storage devices;

means for estimating the command-chaining time between said first and second external storage control devices;

means for estimating a time for a write process, including said estimated command-chaining time, to one of said second group of external storage devices; and

command means for writing data in the write process in a single operation;

wherein in a case where said first external storage control device has received plural write commands for said data from the host, said first external storage control device transfers said write data to said second external storage control device by selecting a transfer method with the shortest processing time; said transfer method with the shortest processing time is selected by considering the command-chaining time between said first external storage control device and said second external-storage control device; and said means for estimating a time for a write process estimates the time before starting the write process to said second external storage control device according to said selected transfer method.

2. A first external storage control device according to claim 1, wherein said means for estimating the command-chaining time estimates according to one of (a) measuring the command-chaining time between a specified command to the next command and (b) setting a length of interface cable between the first and second external storage control devices in advance.

3. A first external storage control device according to claim 1, wherein said means for estimating the command-chaining time estimates the command-chaining time by measuring the time for two command chains.

4. A first external storage control device which is connected to a first group of external storage devices and to a second external storage control device, and which controls data transfer between said external storage devices and a host, wherein,

the second external storage control device is connected to a second group of external storage devices, and controls data transfer between said second group of external storage devices and the host,

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said first external storage control device being equipped with a storing means that stores write data transferred through a write command from the host, a first transfer means to transfer write data to said second external storage control device for each of plural write commands received from the host, and a second transfer means which transfers write data from the host to the second external storage control device for each of plural write commands received from the host by using only one write command, and

the first external storage control device also including means for calculating processing time for data transfer between said first external storage control device and said second external storage control device using said first transfer means and using said second transfer means, means to compare said two processing times and for storing the same data to an external storage device belonging to said first and second group of external storage devices;

wherein when said first external storage control device has received plural write data commands from the host, the external storage control device transfers data from said first external storage control device to said second external storage control device, using a transfer means having the smaller processing time according to the result of said comparing means; and

wherein said transfer means having the smaller processing time is selected by considering the command-chaining time between said first external storage control device and said second external storage control device.

5. A first external storage control device according to claim 4, further comprising:

means for estimating the command-chaining time between said first and second external storage control devices; and

means for estimating a time for a write process, including said estimated command-chaining time, to one of said second group of external storage devices, before starting the write process to said second external storage control device according to said selected transfer means.

6. A first external storage control device according to claim 5, wherein said means for estimating the command-chaining time estimates according to one of (a) measuring the command-chaining time between a specified command to the next command and (b) setting a length of interface cable between the first and second external storage control devices in advance.

7. A first external storage control device according to claim 5, wherein said means for estimating the command-chaining time estimates the command-chaining time by measuring the time for two command chains.

8. A first external storage control device which is connected to a first group of external storage devices and a host

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processor, and which controls data transfer between said first group of external storage devices and said host processor, wherein

said first external storage control device is connected to a second external storage control device that exists a large distance away from said first external storage control device, and which is connected to a second group of external storage devices;

said first external storage control device is equipped with a buffer memory that stores write data transferred by a write command from said host processor and with a function that transfers said write data stored in said buffer memory to said second external storage control device according to the write command;

said first external storage control device has a function to store said write data to one of said external storage devices in said first group and to one of said external storage devices in said second group;

wherein if said first external storage control device has received plural write commands for said data from said host processor, said first external storage control device transfers said write data to said second external storage control device by selecting a transfer method with the shortest processing time; and

wherein said transfer method with the shortest processing time is selected by considering the command-chaining time between said first external storage control device and said second external storage control device.

9. A first external storage control device according to claim 8, further comprising:

means for estimating the command-chaining time between said first and second external storage control devices;

means for estimating a time for a write process, including said estimated command-chaining time, to one of said second group of external storage devices, before starting the write process to said second external storage control device according to said selected transfer method; and

command means for writing data in the write process in a single operation.

10. A first external storage control device according to claim 9, wherein said means for estimating the command-chaining time estimates according to one of (a) measuring the command-chaining time between a specified command to the next command and (b) setting a length of interface cable between the first and second external storage control devices in advance.

11. A first external storage control device according to claim 9, wherein said means for estimating the command-chaining time estimates the command-chaining time by measuring the time for two command chains.

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12. A storage system comprising:

a first plurality of disk drives; and

a disk controller connected to a host processor and said first plurality of disk drives, said disk controller controlling data write from said host processor to said first plurality of disk drives, and data transfer from said first plurality of disk drives to said host processor;

wherein said disk controller is arranged to be connected to another disk controller, and to obtain information on a support function of the another disk controller.

13. A storage system according to claim 12, wherein said disk controller includes means for obtaining the information on the support function of the another disk controller from the another disk controller.

14. A storage system according to claim 13, wherein said disk controller establishes a pair of disk drives, said pair including one of said first plurality of disk drives and one of a second plurality of disk drives which are controlled by the another disk controller; and

wherein said obtaining means obtains the information on the support function of the another disk controller from

the another disk controller when said pair of disk drives is established.

15. A storage system according to claim 12, wherein said disk controller includes a management table for storing the information on the support function of the another disk controller.

16. A storage system according to claim 15, wherein said disk controller further includes means for obtaining the information on the support function of the another disk controller from the another disk controller.

17. A storage system according to claim 16, wherein said disk controller establishes a pair of disk drives, said pair including one of said first plurality of disk drives and one of a second plurality of disk drives which are controlled by the another disk controller; and

wherein said obtaining means obtains the information on the support function of the another disk controller from the another disk controller when said pair of disk drives is established.

18. A storage system according to claim 16, wherein said disk controller stores the information on the support function

of the another disk controller, which information is obtained from the another disk controller by said obtaining means, in said management table.

19. A storage system according to claim 12, wherein said disk controller controls issuance, to the another disk controller, of information that is different according to the support function of the another disk controller.

20. A storage system according to claim 19, wherein said disk controller performs a control according to a first support function of the another disk controller if the another disk controller has the first support function.

21. A storage system according to claim 19, wherein said disk controller controls issuance, to the another disk controller, of information that does not correspond to a second support function, if the another disk controller does not have the second support function.

22. A storage system according to claim 19, wherein said disk controller includes a function determining section for judging the support function of the another disk controller.

23. A storage system according to claim 22, wherein said disk controller includes a management table for storing the information on the support function of the another disk controller.

24. A storage system according to claim 23, wherein said disk controller further includes means for obtaining the information on the support function of the another disk controller from the another disk controller.

25. A storage system according to claim 24, wherein said disk controller establishes a pair of disk drives, said pair including one of said first plurality of disk drives and one of a second plurality of disk drives which are controlled by the another disk controller; and

wherein said obtaining means obtains the information on the support function of the another disk controller from the another disk controller when said pair of disk drives is established.

26. A storage system according to claim 24, wherein said disk controller stores the information on the support function of the another disk controller, which information is obtained from the another disk controller by said obtaining means, in said management table.

27. A storage system according to claim 26, wherein said function determining section judges the support function of the another disk controller in accordance with the information on the support function of the another disk controller in said management table.

28. A storage system according to claim 19, wherein said disk controller does not issue a specified command to the another disk controller, if said disk controller judges from the information on the support function of the another disk controller that the another disk controller does not accept the specified command.

29. A storage system comprising:

a first plurality of disk drives; and

a disk controller connected to a host processor and said first plurality of disk drives, said disk controller controlling data transfer from said first plurality of disk drives to said host processor;

wherein said disk controller is connected to another storage system, and said disk controller transfers a read command, received from the host processor, to the another storage system, in the case where object data for the read command exists in the another storage system.

30. A storage system according to claim 29, wherein said disk controller controls data write from said host processor to said first plurality of disk drives; and

wherein said disk controller includes means for confirming that object data for the read command or a write command received from the host processor exists in the another storage system, and means for transferring the read command or the write command from the disk controller to the another storage system.

31. A storage system comprising:

a first plurality of disk drives; and

a disk controller connected to said first plurality of disk drives, said disk controller controlling data write from said host processor to said first plurality of disk drives, and data transfer from said first plurality of disk drives to said host processor;

wherein said disk controller is connected to another disk controller which supports another function against said disk controller.